CARGO TRAILER ANTI-TERRORIST AND ANTI-THEFT SYSTEM

BACKGROUND OF THE INVENTION

Cross-reference to related application

The present application is a continuation-in-part of pending application serial number 09/466,655 filed on December 20, 1999.

Field of the Invention

The present invention is in the field of electro-mechanical devices designed to provide the means to intercept and terminate a terrorist's or renegade's use of cargo trailers (and like vehicles equipped with air brakes) for delivering explosive or hazardous materials to a potential target. A collateral benefit is its capability to deter theft of vehicles with air brakes. More particularly, the present invention is directed to a device or system that remotely locks the brakes of trailers, tractors, fuel tankers, and like vehicles (that are equipped with dual chamber air brakes) with a coded radio signal.

Brief Description of the Prior Art

Cargo-trailers, tractors, fuel tankers and like vehicles are capable of being used to deliver hazardous material for terrorist attacks on vulnerable targets. These vehicles may have been stolen or rented under false pretenses. In the case of trailers and like equipment that do not have their own motive power (engines), compressed air for operating the brake system is supplied through a conduit from the tractor or truck that pulls the trailer. Such trailers and the like towed equipment, as well as many tractors and trucks, are usually equipped with a dual chamber brake system that operates in such a manner that the brakes are automatically locked if pressurized air becomes

unavailable. In order to take such a trailer without authorization, that is to steal it when it is parked, the thief typically mates a tractor to the trailer and supplies pressurized air to the dual chamber brake system of the trailer. In other words, by hooking up the thief's tractor's or truck's air pressure conduit to the brake system of the trailer, the thief is able to release the brakes and Pull the trailer with the brakes operating normally. To this date and to the best knowledge of the present inventor, the state-of-the-art has attempted to prevent or discourage the theft of cargo-trailers by providing devices that make it difficult for an unauthorized person to access the trailer's hitch or "fifth wheel" or by providing a keyed cover ("glad hand" cover) that prevents attachment of a pressurized air conduit to the pressurized air inlet of the dual chamber air brake system of the trailer. Experience has shown however, that a determined thief circumvents these devices relatively easily.

Additional disclosures pertaining to brake systems, and to means for locking brake systems for various reasons and not necessarily for preventing theft are found in United States Patent Nos. 3,597,016; 3,826,176; 4,007,815; 4,014,414; 4,014,579; 4,268,093; 4,273,388; 4,589,704; 4,685,744; 4,873,824; 5,402,866; Re. 32,885; Statutory Invention Registration Nos. H117 and H748. United States Patent numbers 4,354,536 and 6,076,385 include additional disclosures pertaining to some type of locking or latching mechanism.

Therefore, there is still a serious need in the art for a device or system that renders the dual chamber air brake system of a trailer (or of a tractor) non-operational for unauthorized users. The present invention provides such a system. In addition there is a serious need in the art for means that enables law

enforcement and the like to remotely stop a renegade vehicle which is suspected of being loaded with hazardous material on route to a target. The present invention provides such means.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a secure and difficult to circumvent remote braking and / or brake locking device for trailers, tractors, or other vehicles equipped with dual chamber air brake systems, which can be initiated (and released) only by an authorized organization or individual.

It is another object of the invention to provide means for remotely stopping a trailer, tractor, or other vehicle equipped with dual chamber air brake system by using a coded signal which is available only to law enforcement agencies or authorized organizations or individuals.

It is still another object of the present invention to provide the locking device that meets the above-noted objective, and which operates within the interior of the dual chamber air brake system, thereby making it more difficult and time consuming to disassemble or inactivate the locking device and make unauthorized use of the trailer, tractor, or other vehicle equipped with the device less likely.

The foregoing and other objects and advantages are attained by a remotely activated device that has means mounted within the interior of the dual chamber brake system which, responsive to a coded signal, vents pressure in the emergency chamber of a dual chamber brake system to automatically apply the brakes thereby bringing a moving vehicle to a stop. This coded

signal is ideally made available only to law enforcement agencies and the like. Upon receiving a different coded signal, usually available only to persons who are authorized users of the trailer or vehicle, the device also vents pressure in the emergency chamber and locks the brakes and blocks the brake actuator rod from being retracted into its non-braking operative position by preventing pressurized air from being supplied to the dual chamber brake system of a stopped or parked vehicle. The means for accomplishing these objectives is an electro mechanical device such as a solenoid valve which is remotely actuated by the above-noted coded signals that can only be transmitted by an authorized user or users. This solenoid valve is internally located, preferably at the air inlet port in the emergency chamber of the dual chamber brake system.

The features of the present invention can be best understood together with further objects and advantages by reference to the following description taken in connection with the accompanying drawings wherein like numerals indicate like parts.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of a typical dual chamber air brake system in accordance with the state-of-the-art, showing the air brakes in a locked position in a situation when pressurized air is not present in the system.

Figure 2 is a sectional view of a typical dual chamber air brake system in accordance with the state-of-the-art, showing the air brakes in a situation when pressurized air is present in the emergency chamber and the brakes are not applied.

Figure 3 is a sectional view of a typical dual chamber air brake system in accordance with the state-of-the-art, showing the air brakes in a situation when pressurized air is present in the emergency chamber and modulated in the service chamber to partially deploy the brakes.

Figure 4 is a sectional view of a typical dual chamber air brake system in accordance with the state-of-the-art, showing the air brakes in a situation when pressurized air is present in both the emergency and service chamber and the brakes are fully deployed.

Figure 5 is a sectional view of the service brake housing of a dual chamber brake system incorporating the preferred embodiment of the present invention showing the embodiment activated with the brakes in a locked position.

Figure 6 is a cross-sectional view taken on lines 6.6 of Figure 5.

Figure 7 is a sectional view of the service brake housing of a dual chamber brake system incorporating the preferred embodiment of the security locking device of the present invention showing the embodiment not activated, with pressurized air supplied to the emergency housing chamber but the brakes not deployed.

Figure 8 is a cross- sectional view taken on lines 8.8 of **Figure 7**.

Figure 9 is an electrical schematic of the preferred embodiment shown in Figure 5 when a moving vehicle is brought to a halt by law enforcement action.

Figure 10 is an electrical schematic of the preferred embodiment shown in Figure 5 when a moving vehicle is parked and secured against theft by the authorized operator.

Figure 11 is an electrical schematic of the preferred embodiment shown in Figure 7 with the vehicle available for normal operation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following specification taken in conjunction with the drawings sets forth the preferred embodiment of the present invention. The embodiment of the invention disclosed herein is the best mode contemplated by the inventor for carrying out his invention in a commercial environment, although it should be understood that various modifications can be accomplished within the parameters of the present invention.

The present invention is best explained and understood in conjunction with a thorough understanding of the operation of the dual chamber air brake system that is constructed in accordance with the state-of-the-art. For this reason operation of the common state-of-the-art dual chamber air brake system is first explained with reference to **Figures 1** through **4**. The present invention is adapted to operate with such common dual chamber air brake system, with such modifications of the basic system that are required to incorporate into and integrate with it the security locking device of the invention.

Referring now to **Figures 1** through **4**, the state-of-the-art dual chamber brake system includes a housing **30** having two chambers with a common bulkhead **32**. The first of the two chambers is the service housing chamber **34**

and the second is the emergency housing chamber **36**. Each of the two chambers **34** and **36** is divided into two parts by a flexible and stretchable diaphragm, termed the service diaphragm **38** and the emergency diaphragm **40**, respectively. Each of the two chambers **34** and **36** has a separate inlet port for compressed air, that is, there is a service chamber pressure port **42** and an emergency chamber pressure port **44**. A line, conduit or hose (not shown) conducting compressed air can be attached to each port **42** and **44**, and is actually attached when the brakes are dynamically operated, that is when the trailer (not shown), truck (not shown), or other vehicle (not shown) having the dual chamber brake system is moved. In the event the vehicle is a trailer (not shown) without its own supply of compressed air then the conduits (not shown) attached to the ports **42** and **44** supply compressed air provided by the truck (not shown), or other towing vehicle (not shown) which pulls the trailer (not shown). In this connection it should be understood that the anti-theft feature of present invention is primarily intended for trailers because these are the most vulnerable for theft, but this feature of the present invention can also find application in any vehicle or equipment that has a dual chamber air brake system and which can be immobilized to prevent or hinder unauthorized removal. The "anti-terrorism" feature of the present invention, that is the feature that allows a moving vehicle to be remotely stopped by a coded signal, is considered equally useful and certainly equally applicable to trailers and to self-propelled vehicles as well.

Each of the two chambers **34** and **36** has a vent **46** that permits escape of air from the non-pressurized air space when the space behind the respective

diaphragm **38** or **40** is pressurized with compressed air. The vented space in the emergency housing chamber **36** has a pressure plate **48** located between a high spring-rate (powerful) spring **50** and the diaphragm **40**. A guide **52** links the movement of the pressure plate **48** in the emergency housing chamber **36** to the service diaphragm **38** in the service housing chamber **34** and to a push plate **54** that is located in the service housing chamber **34** between the service diaphragm **38** and the front wall of the service housing **34**. The guide **52** includes a rod **56** that travels through an opening **58** in the common bulkhead. The rod **56** allows reciprocation of the guide **52** in the longitudinal direction relative to the two housings **34** and **36**. A low spring-rate spring **60** is disposed between the push plate **54** and the front wall of the service housing **34**. Two bolts **62** that attach the dual chamber brake system to the trailer (not shown), tractor (not shown), or other vehicle (not shown) are shown in the front of the housing **34**, although more than two bolts may be used. A removable plug **64** is located in the back wall of the emergency housing chamber **36**. The purpose of the removable plug **64** is to allow access with a special tool (not shown) into the interior of the emergency housing chamber **36**. The low spring-rate spring **60** in the service housing **34** is significantly weaker than the high spring-rate spring **50** in the emergency housing **36**. The push plate **54** is connected to a brake actuator rod **66** which passes through an opening **68** in the front wall of the service housing chamber **34**. It will be readily understood by those skilled in the art that longitudinal movement of the brake actuator rod **66** "controls" the actual brakes of the wheels (not shown); forward movement applies them and rearward movement, that is retraction, releases them.

Figure 1 shows the state-of-the-art dual chamber brake system in a situation when compressed air is not provided to either chamber **34** or **36**. This occurs usually when the trailer (not shown), truck (not shown), or other vehicle (not shown) is parked. In this situation the high spring-rate spring **50**, overcoming the contrary force of the low spring rate spring **60** and compressing the same, pushes the guide **52** forward and thereby forces the push plate **54** and the brake actuator rod **66** forward, fully applying the actual wheel brakes (not shown). In such a situation the wheel brakes are locked and the trailer (not shown), tractor (not shown), or other vehicle (not shown) cannot be moved. However, when compressed air is supplied to the emergency chamber pressure port **44**, as is shown in **Figure 2**, then the high spring-rate spring **50** in the emergency housing chamber **36** is compressed and the low spring rate spring **60** causes the push plate **54** and the brake actuator rod **66** to retract thereby disengaging the wheel brakes (not shown). The trailer (not shown), tractor (not shown), or other vehicle (not shown) can now move normally. **Figure 3** shows the state- of-the-art dual chamber brake system with the brakes applied, as they would be when a driver (not shown) wishes to slow a moving vehicle (not shown). In this situation, due to application of the brake pedal (not shown) a measured pressure of compressed air is applied in the service housing chamber **34** through the service chamber pressure port **42**, the service diaphragm 38 moves forward, the low spring-rate spring **60** is partially compressed, the brake actuator rod **66** is pushed forward by the push plate **54** and the wheel brakes are applied. **Figure 4** shows the situation when the brakes are applied fully by applying full pressure of compressed air in the

service housing chamber **34**. However, it can be seen that compressed air is still supplied to the emergency housing chamber **36**, and the high spring-rate spring **50** is still compressed: the brakes are applied but not "locked" as they would be when the trailer (not shown) is parked without a supply of compressed air to the brakes.

Figures 5 through **11** illustrate the preferred embodiment of the anti-theft security device of the present invention mounted into an otherwise state-of-the-art dual chamber brake system. In this connection it will become apparent and should be understood that the dual chamber brake system is modified to the extent necessary to accommodate and cooperate with the anti-terrorist and anti-theft, brake-locking security device or system. Moreover, while the present specification discloses generic principles and a presently preferred embodiment, several other hardware configurations can be built in light of the present disclosure to restrain the brakes in the locked condition without departing from the spirit of the present invention. Therefore, it is not desired to confine the invention to any of the exact forms shown in this specification, but rather to include them as broadly as is the scope of the invention.

In accordance with invention, and in the herein described preferred embodiment, a solenoid valve **100** or the like electro-mechanical valving device is employed to control the flow of pressurized air into and out of the emergency housing chamber **36** to stop a moving vehicle equipped with dual chamber air brakes or to secure such a vehicle against unauthorized removal in a parked condition.

The solenoid valve **100** as a component in the apparatus of the present invention is responsive to electrical current (or lack of it) the flow of which is enabled by a receiver decoder **102** that is itself responsive to coded signals, such as electromagnetic or infra red signals akin to the signals that are virtually ubiquitously used in modern times for opening and locking car doors and the like by remote control. The coded signals may be sent by a hand-held "remote control" transmitter, schematically shown in the drawings as **69**, that is ideally possessed only by law enforcement and by persons authorized to operate the trailer (not shown), truck (not shown), or other vehicle (not shown) or to stop its unauthorized operation. When the remote control transmitter is hand-held then it can be characterized as portable.

Alternatively, the coded signals may be supplied to the solenoid valve **100** or like electro mechanically actuated valving device from a transmitter built into the cab of the towing vehicle (not shown) or a hard wire connection (rather than by radiation) in certain of the applications. However, for the anti-terrorism feature of the invention whereby a moving vehicle can be stopped by law enforcement or the like using a coded signal, it is necessary for the receiver decoder **102** to be responsive to a signal originating from a remote source, which may or may not be hand held. Power to operate the solenoid valve **100** or like electro-mechanical valving device can be supplied by batteries in the trailer (not shown), truck (not shown), or other vehicle (not shown). In any event, the solenoid valve **100** or like electro mechanical valving devices and the receiver decoder **102** which are used as components of the apparatus of the present invention and which are responsive to a coded

signal, are readily available in the state-of-the-art, and need not be described further. In the presently preferred embodiment the receiver decoder **102** is located in a different housing than the solenoid valve **100** or like electro mechanical valving device, and this configuration is shown in the drawing figures. However, it is possible to mount the solenoid valve **100** or like electro mechanical valving device and the ~~solenoid valve~~ reciever decoder 102 January 28 2002 in the same housing, and such configuration or variations of these configurations are also within the scope of the invention.

In the first preferred embodiment, shown in **Figures 5** and **6,** the normally closed solenoid valve **100** with its coil de-energized vents air from the emergency housing chamber **36** through a flexible vent conduit **106** through a duct formed in the guide ~~and 56~~ 52 January 28 2002 and pressure plate **48** into the un-pressurized portion of the emergency housing chamber **36**. The duct and its vent orifice emptying into the un-pressurized portion of the emergency housing chamber **36** bears the reference numeral **108**. Air vented through the flexible vent conduit **106** and through the ducts **108** can escape into the environment through the vent **46** in the wall of the emergency housing chamber **36**. In addition, in its closed, de-energized position the solenoid valve **100** blocks passage of air through the emergency chamber pressure port **44** and thereby prevents pressurized air from being re-supplied to the emergency housing chamber **36**. When in this condition, the brakes are fully applied and the vehicle is stopped.

Figures 9, 10 and **11** depict an electrical circuit which in the herein described preferred embodiment controls the solenoid valve **100** and brings

about its closed or open, that is de-energized or energized positions. As it can be seen in these three figures, the electrical circuit consists of two paths (**110** with a proximity or limit switch **114**, and **112** with a first switch **116**) in parallel with each other and in series with a third path (**120** with a second switch **118**) connecting the power source **109** (battery) and the solenoid valve **100**. The circuit itself is advantageously incorporated in the same housing which includes the receiver decoder **102**, or it can be incorporated in the housing of the solenoid valve **100**, or in a housing separate (not shown) from either of these devices, and other variations of these configurations are also possible within the scope of the invention. Two of the three switches, **116** and **118**, of the circuit are opened and/or closed responsive to coded signals sent to and received by the receiver decoder **102**. The third switch is a proximity or limit switch **114**, also shown in **Figures 5** and **7,** that is normally closed unless opened by contact with the base of guide **52**. The function and purpose of this proximity or limit switch **114** are explained below. With all three switches **114**, **116**, and **118** closed as shown in **Figure 11**, the solenoid valve **100** is energized to admit pressurized air into the emergency housing chamber **36** compressing the high spring-rate spring **50** placing the brake system in normal operating condition. **Figures 7** and **8** show the brake in this mode.

Referring now primarily to **Figure 9** the state of the circuit is shown when the trailer, tractor, or vehicle is stopped by emergency law enforcement or like action. The emergency law enforcement action may be initiated to stop a terrorist vehicle heading toward a restricted area, or a stolen or run-away vehicle refusing to stop when ordered, or such other circumstance that law

enforcement deems appropriate. To bring about this status of the circuit and thereby activate the device of the invention in such situation (that is, to stop a moving vehicle), a unique coded signal (first signal or anti-terrorist signal) is transmitted to the receiver decoder **102** which then opens the second switch **118** and thereby the electrical circuit, regardless of the condition of switches **114** and **116**, depriving the solenoid valve **100** of power. The unique coded signal is ideally available only to security and law enforcement agencies or organizations, in other words to persons or organizations who can be trusted and even relied on to stop a moving trailer or vehicle. As it is apparent from the foregoing description and inspection of **Figures 5** and **6**, de-energizing the solenoid valve **100** returns it to the normally closed condition, venting the air from the emergency housing chamber **36** and blocking entry of pressurized air through the emergency chamber pressure port **44** with the result that the brakes of the vehicle are applied fully and the vehicle is brought to an abrupt stop. Another unique coded signal (second signal) may be available to law enforcement to close the second switch **118** to enable the trailer, tractor, or other vehicle to move again, after the danger of terrorist action or like emergency has passed.

Figure 5 shows the status of the brake system when parked, that is, the brakes fully applied and the emergency housing chamber **36** vented. In this parked condition the base of guide **52** is forced against the proximity or limit switch **114** by the expansion of the high spring-rate spring, thereby opening switch **114** and the electrical circuit in one of the parallel paths **110** as shown in **Figure 10**. Thus when the vehicle is parked, and only when it is parked, the

anti-theft feature of the invention can be activated by opening the electrical circuit in the second parallel path **112** to de-energize the solenoid valve **100** even if the second switch **118** in path **120** is closed. When de-energized, the solenoid valve is closed and pressurized air cannot be supplied to the emergency housing chamber **36**. To accomplish this, the driver (not shown) or other authorized individual sends a coded signal (anti-theft or third signal) to the receiver decoder **102** to open the first switch **116** in path **112**. This coded signal (anti-theft signal or third signal) is ideally available only to the owner of the trailer, tractor, or other vehicle equipped with the device of the present invention, or to persons authorized by the owner.

Still another coded signal, fourth signal (or "to go" signal) ideally available only to the driver or to persons authorized by the owner closes the first switch **116** thereby supplying power to the solenoid valve **100**. The circuit in the "to go" operating state of the trailer, tractor, or vehicle is depicted in **Figure 11** and the operating mode of the dual purpose brake system is shown in **Figures 7** and **8**. In this condition the solenoid valve is energized, pressurized air is supplied through the emergency chamber pressure port **44** into the emergency housing chamber **36** to compress the high spring-rate spring **50** allowing the low spring-rate spring **60** in the service chamber **34** to expand and release the brake actuating rod **66** from the locked position and allow the braking system to respond to the driver's modulation of the brake pedal (not shown) for normal brake operation.

It can be seen from the **Figure 7** that when the trailer, tractor or vehicle equipped with the device of the present invention is in normal operating mode,

the base of the guide **52** is not juxtaposed to the proximity or limit switch **114** and therefore the proximity or limit switch **114** remains closed. If in this condition of the device, a coded signal such as the anti-theft or third signal (or a signal akin to it which is perceived by the receiver decoder as the anti-theft, or third signal) was inadvertently or accidentally given, then the first switch **116** in path **112** would open, but the electrical circuit through the proximity or limit switch **114** in path **110** would still remain closed supplying power to the solenoid valve and thereby preventing unintentional locking of the brakes of the tractor, trailer, or vehicle while it is moving.

Those skilled in the art will readily understand that the above description teaches generic principles as well as discloses a presently preferred embodiment, and that several mechanical equivalents of the herein described device may become apparent to those skilled in the art in light of the present disclosure. Similarly, numerous electrical and electronic equivalents of the simple electrical circuit disclosed herein may become readily apparent to those skilled in the art in light of the present disclosure. Nevertheless such mechanical, electrical and electronic equivalents are intended to be within the scope of the present invention. Examples of such equivalent include the employment of a piston in place of the emergency chamber diaphragm, and many variations in other hardware, arrangement of the ports and vents. Other equivalents are using solenoid valves which are normally closed when power is supplied, requiring a rearrangement of the electric circuit, still well within the skill of the ordinary artisan in light of the present disclosure. Nevertheless, the embodiment disclosed herein is presently thought to be the preferred one

to manufacture and provide the best security and compatibility with current dual chamber air brake systems in use on a multitude of trailers and vehicles to guard both against unauthorized use (theft) and to enable law enforcement to stop a moving vehicle when the circumstances render this necessary.

In one apparent alternative embodiment the electronic circuit may include only the second switch **118** (or an electric or electronic equivalent), and the receiver decoder **102** is responsive only to the first (anti-terrorist) coded signal to open the second switch **118** and thereby stop a moving vehicle, and to a second coded signal which would cause the second switch **118** to close. Ideally, these coded signals would be made available only to law enforcement or the like, thereby providing the trailer, tractor or vehicle equipped with a dual chamber brake system an this embodiment of the present invention only with the anti-terrorist feature of the invention.